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(54) **AUDIO CONTROL SYSTEM FOR A VEHICLE**

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(51) **Int. Cl.**

H04H 60/04	(2008.01)
H04R 27/00	(2006.01)
H04N 11/00	(2006.01)
H04R 29/00	(2006.01)

(52) **U.S. Cl.**

USPC **381/123**; 381/81; 381/85; 381/86; 381/77; 381/56; 381/58

(58) **Field of Classification Search**

USPC 381/86, 123, 120, 56, 58, 77, 80, 81, 85

See application file for complete search history.

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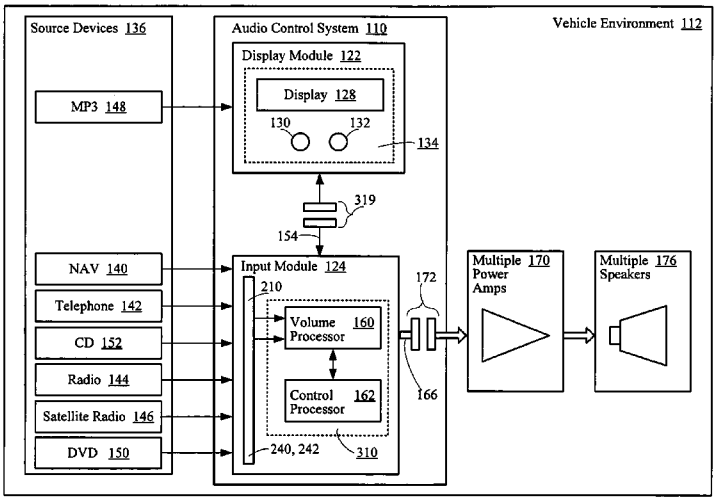
(57) **ABSTRACT**

An audio control system may receive a plurality of audio input signals. A switch or multiplexer may switch one of the plurality of audio input signals from respective audio sources to a power amplifier. A controller in communication with the multiplexer may control switching of the multiplexer. A display may provide the user with information regarding the switching of the audio signal inputs. A user interface may permit the user to manually switch the audio source. A signal detector in communication with an audio input signal may detect a signal from a priority source. When the signal from the priority source is detected, the controller may direct the multiplexer to route the signal from the priority source to the power amplifier.

16 Claims, 10 Drawing Sheets



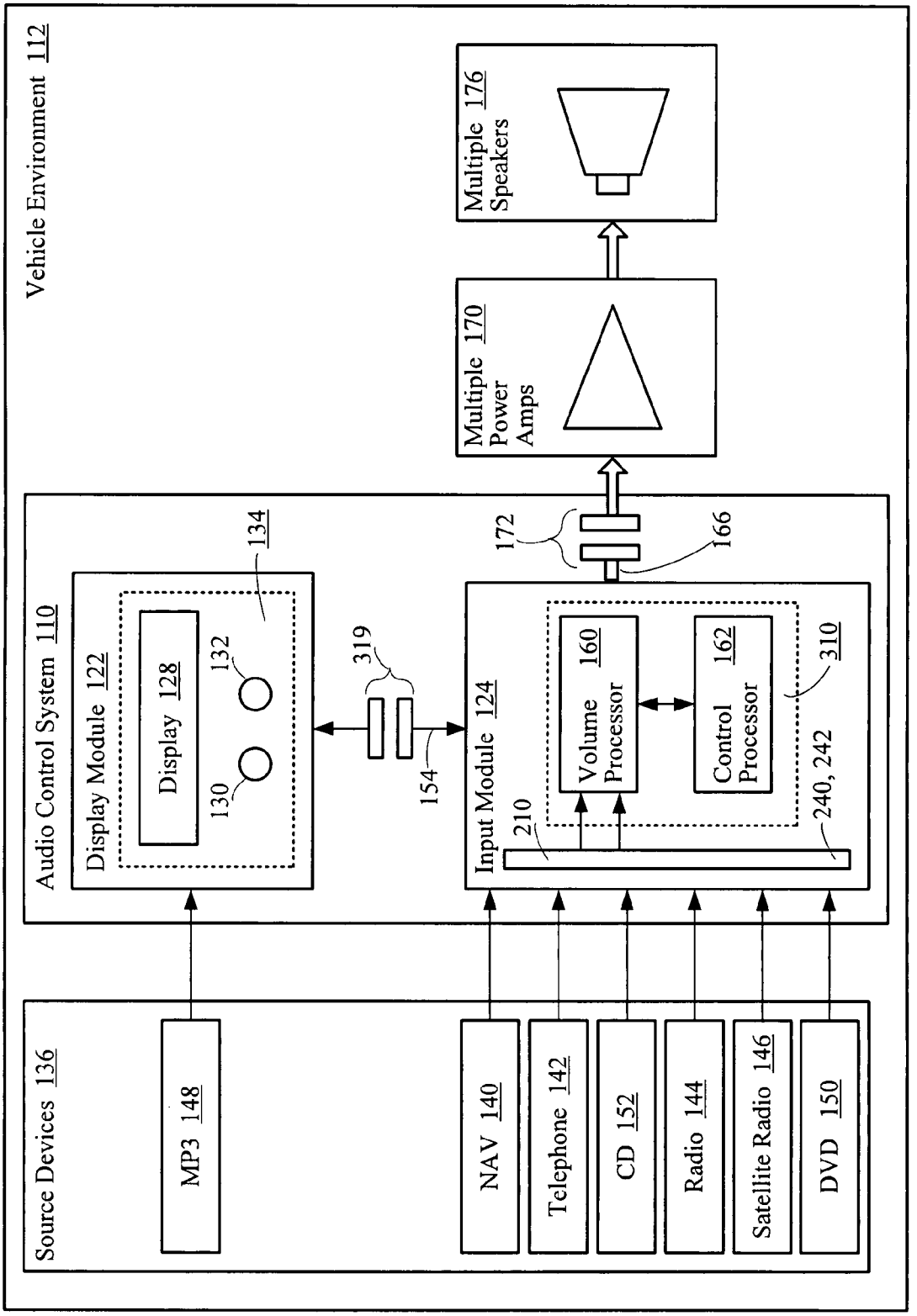

Vehicle Environment 112
Multiple 176 Speakers
Multiple 170 Power Amps
172
166
Audio Control System 110
Display Module 122
Display 128
134
132
130
319
154
Input Module 124
210
Volume Processor 160
Control Processor 162
310
240, 242
Source Devices 136
MP3 148
NAV 140
Telephone 142
CD 152
Radio 144
Satellite Radio 146
DVD 150

Figure 1

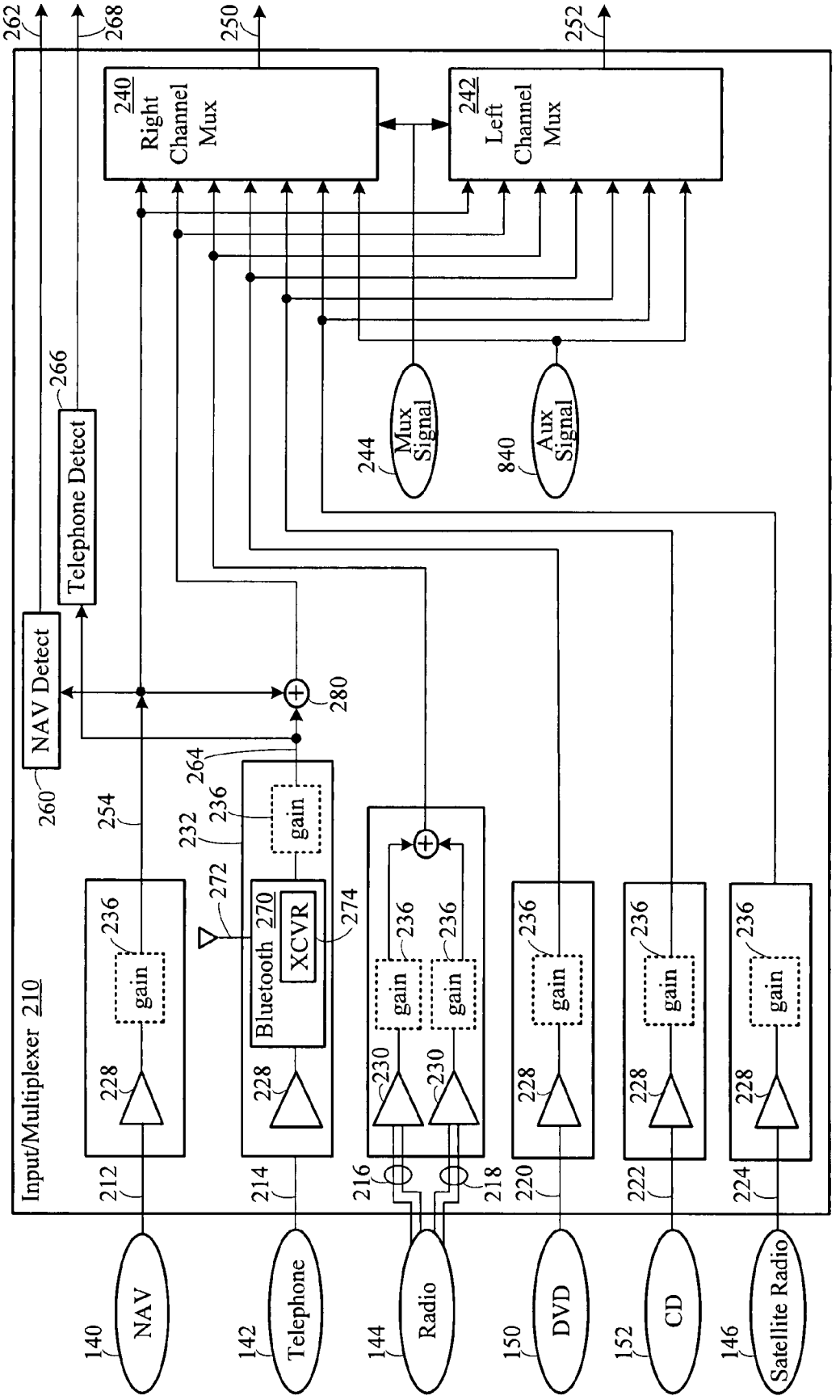

262
268
250
252
240 Right Channel Mux
242 Left Channel Mux
266
Telephone Detect
244 Mux Signal
840 Aux Signal
NAV Detect
260
280
264
254
232
236
gain
272
Bluetooth 270
XCVR
274
Input/Multiplexer 210
228
230
212
214
216
218
220
222
224
140 NAV
142 Telephone
144 Radio
150 DVD
152 CD
146 Satellite Radio

Figure 2

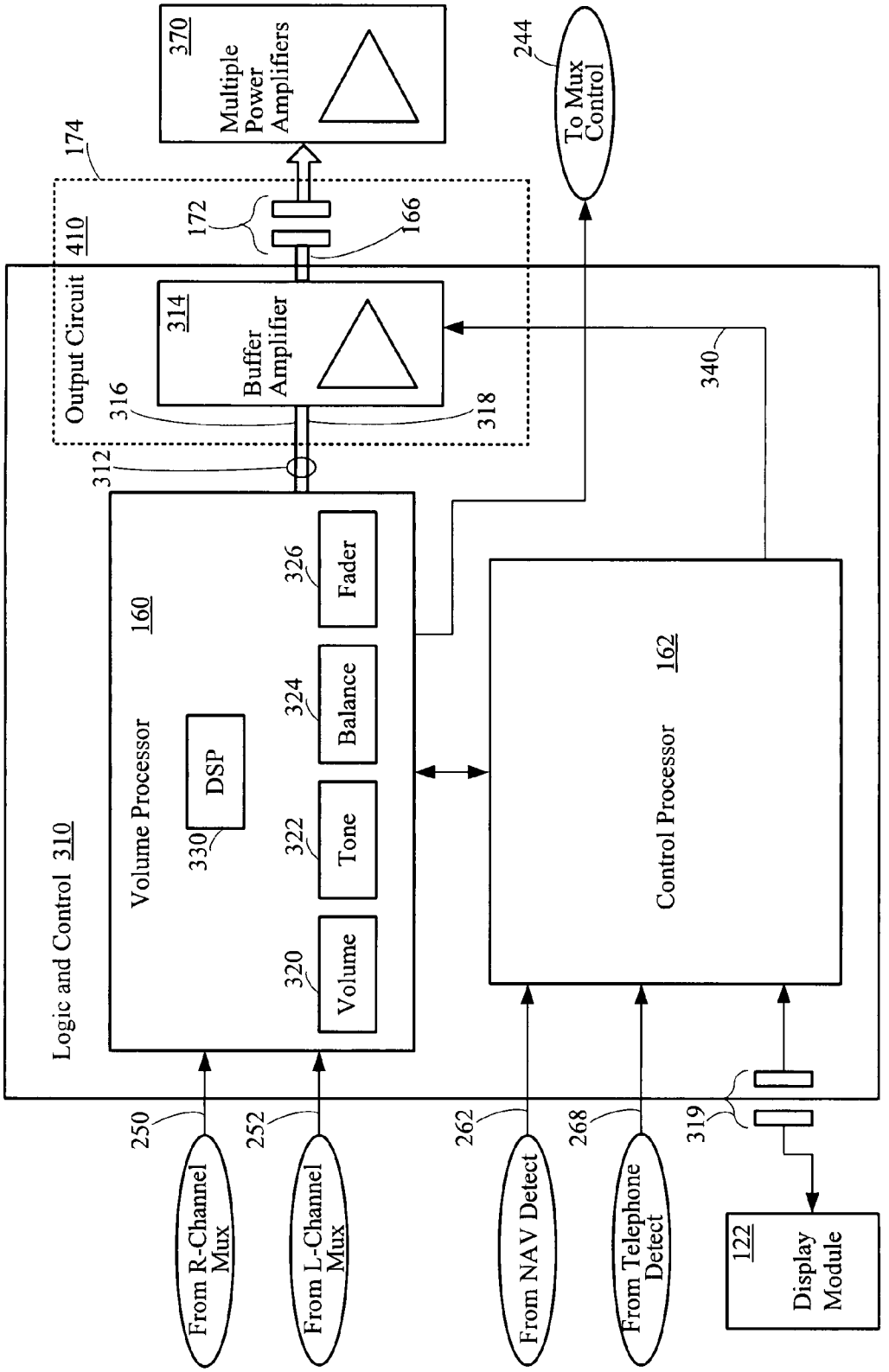

370
Multiple Power Amplifiers
174
Output Circuit 410
172
166
244
To Mux Control
314
Buffer Amplifier
316
318
312
340
Logic and Control 310
Volume Processor 160
DSP
330
326
Fader
324
Balance
322
Tone
320
Volume
Control Processor 162
250
252
262
268
319
From R-Channel Mux
From L-Channel Mux
From NAV Detect
From Telephone Detect
122
Display Module

Figure 3

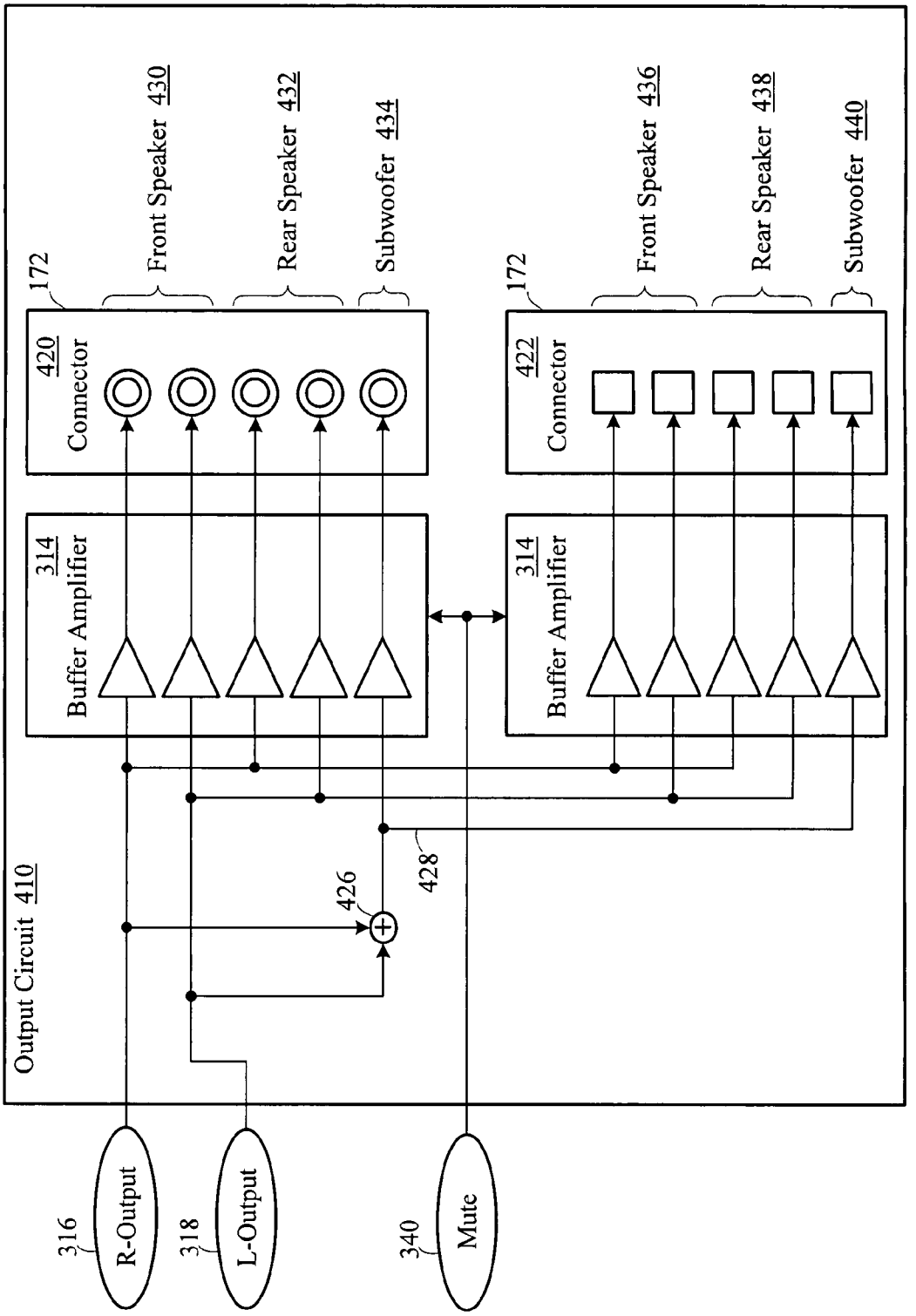

Output Circuit 410
172
420 Connector
Front Speaker 430
Rear Speaker 432
Subwoofer 434
314 Buffer Amplifier
172
422 Connector
Front Speaker 436
Rear Speaker 438
Subwoofer 440
314 Buffer Amplifier
426
428
316 R-Output
318 L-Output
340 Mute

Figure 4

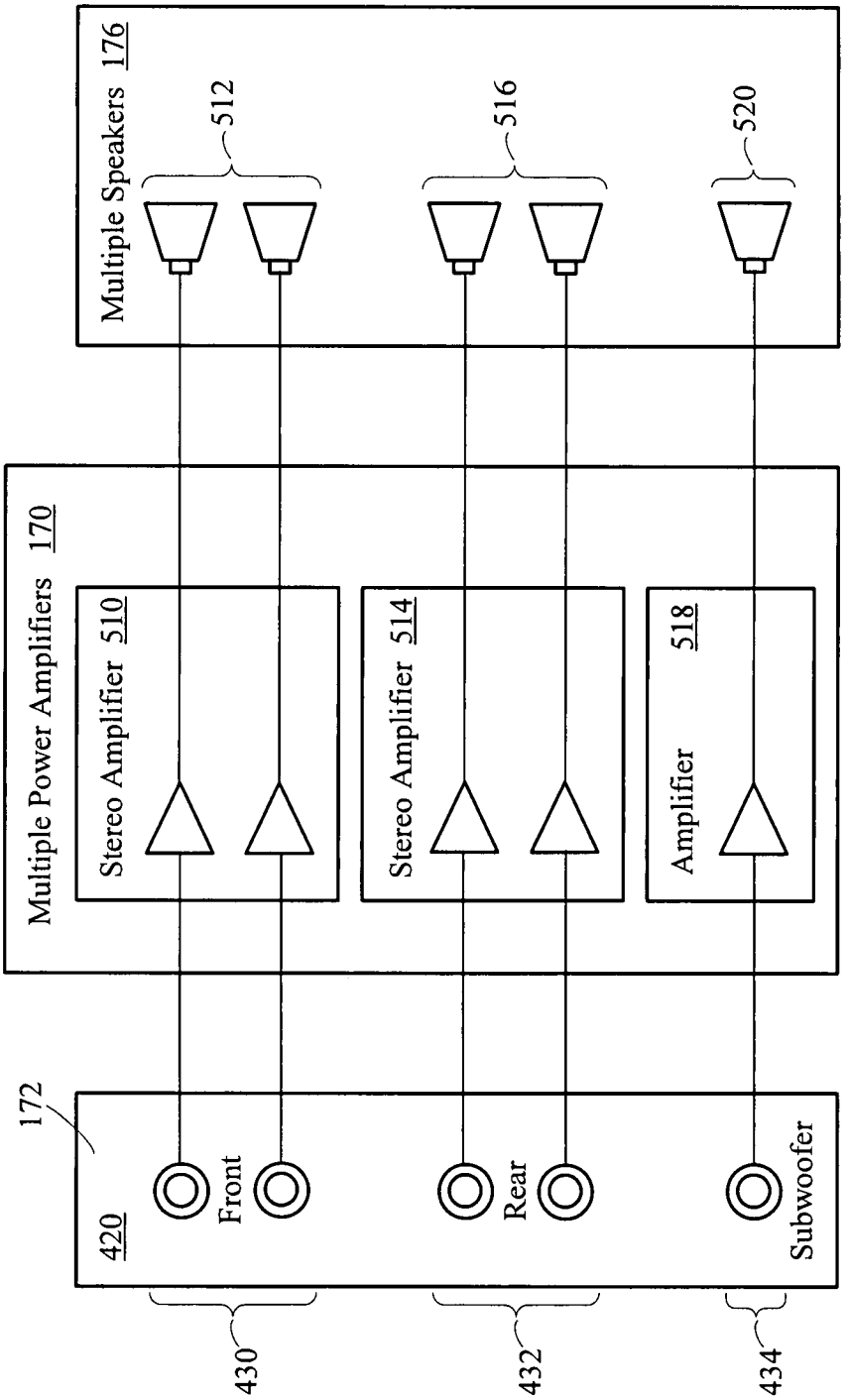

Multiple Speakers 176
512
516
520
Multiple Power Amplifiers 170
Stereo Amplifier 510
Stereo Amplifier 514
Amplifier 518
172
420
Front
Rear
Subwoofer
430
432
434

Figure 5

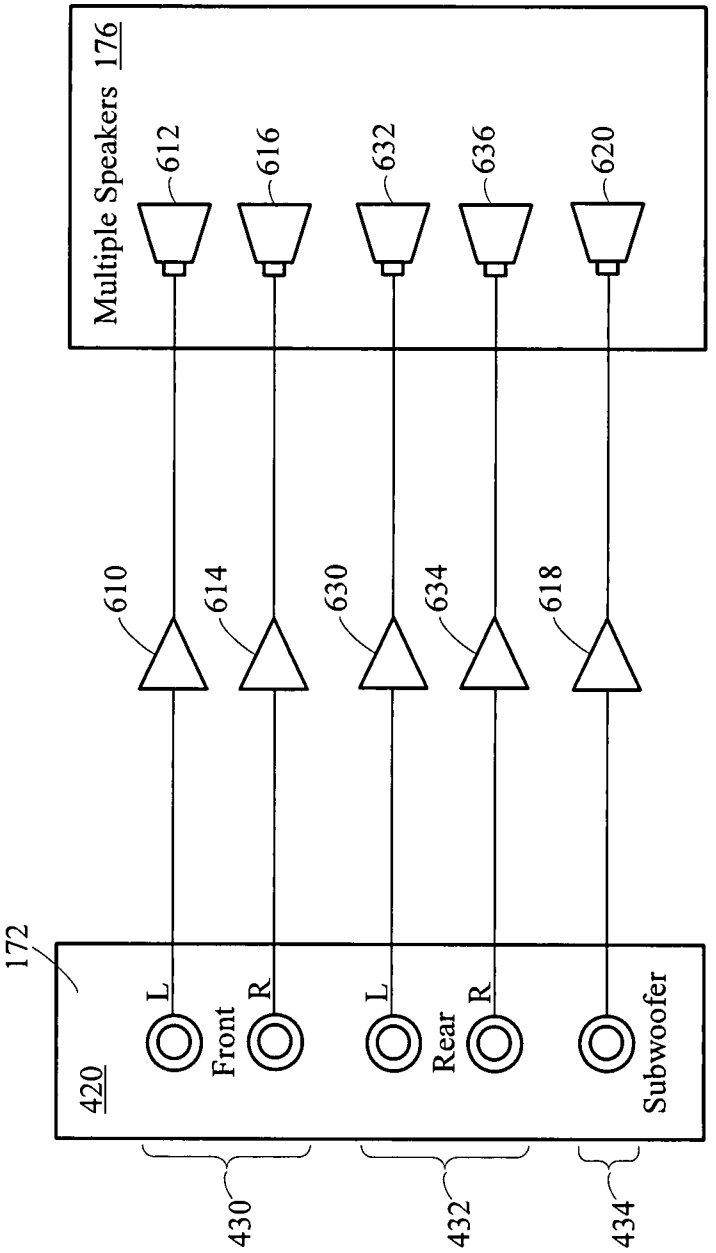

Multiple Speakers 176
612
616
632
636
620
610
614
630
634
618
172
420
L
Front
R
L
Rear
R
Subwoofer
430
432
434

Figure 6

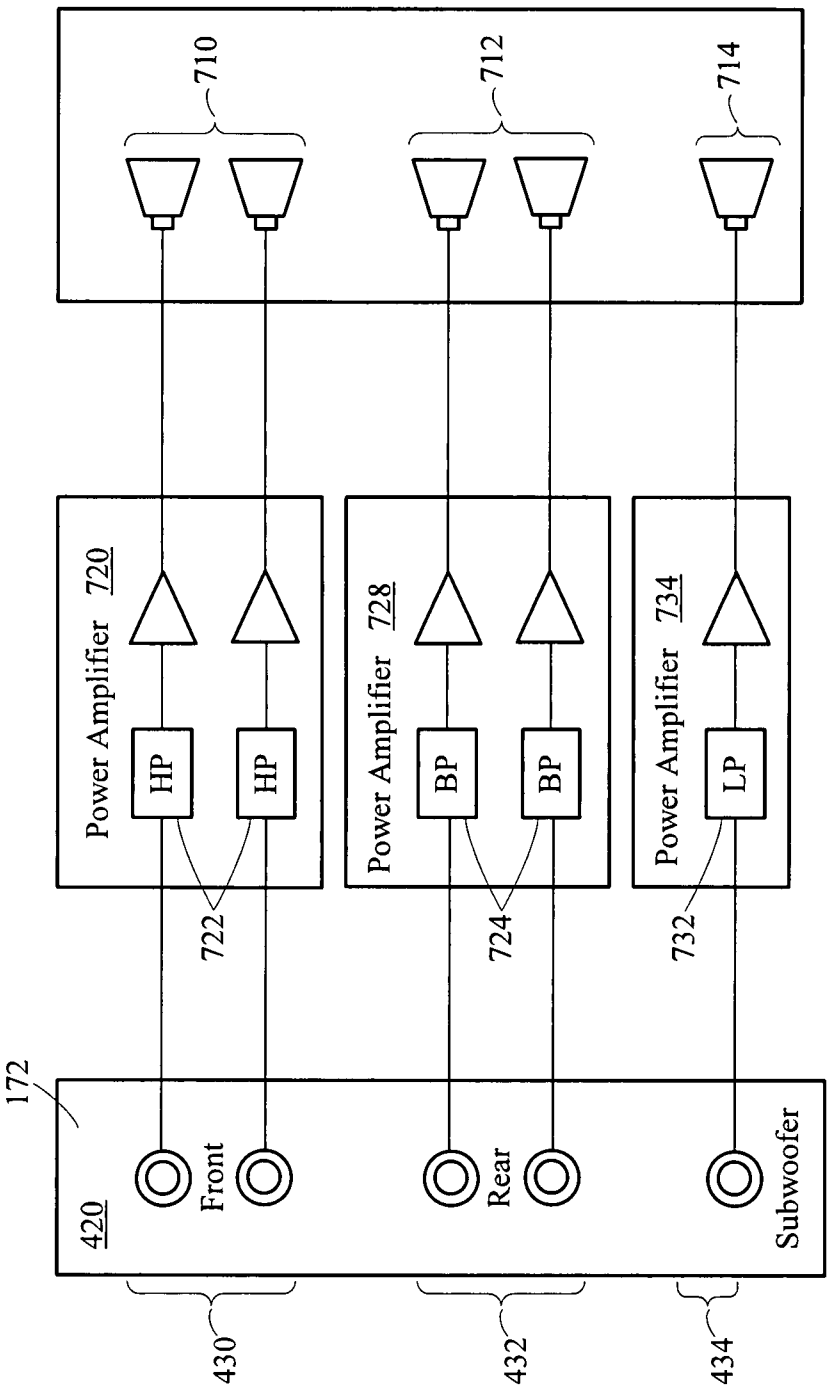

710
712
714
Power Amplifier 720
HP
HP
Power Amplifier 728
BP
BP
Power Amplifier 734
LP
722
724
732
172
420
Front
Rear
Subwoofer
430
432
434

Figure 7

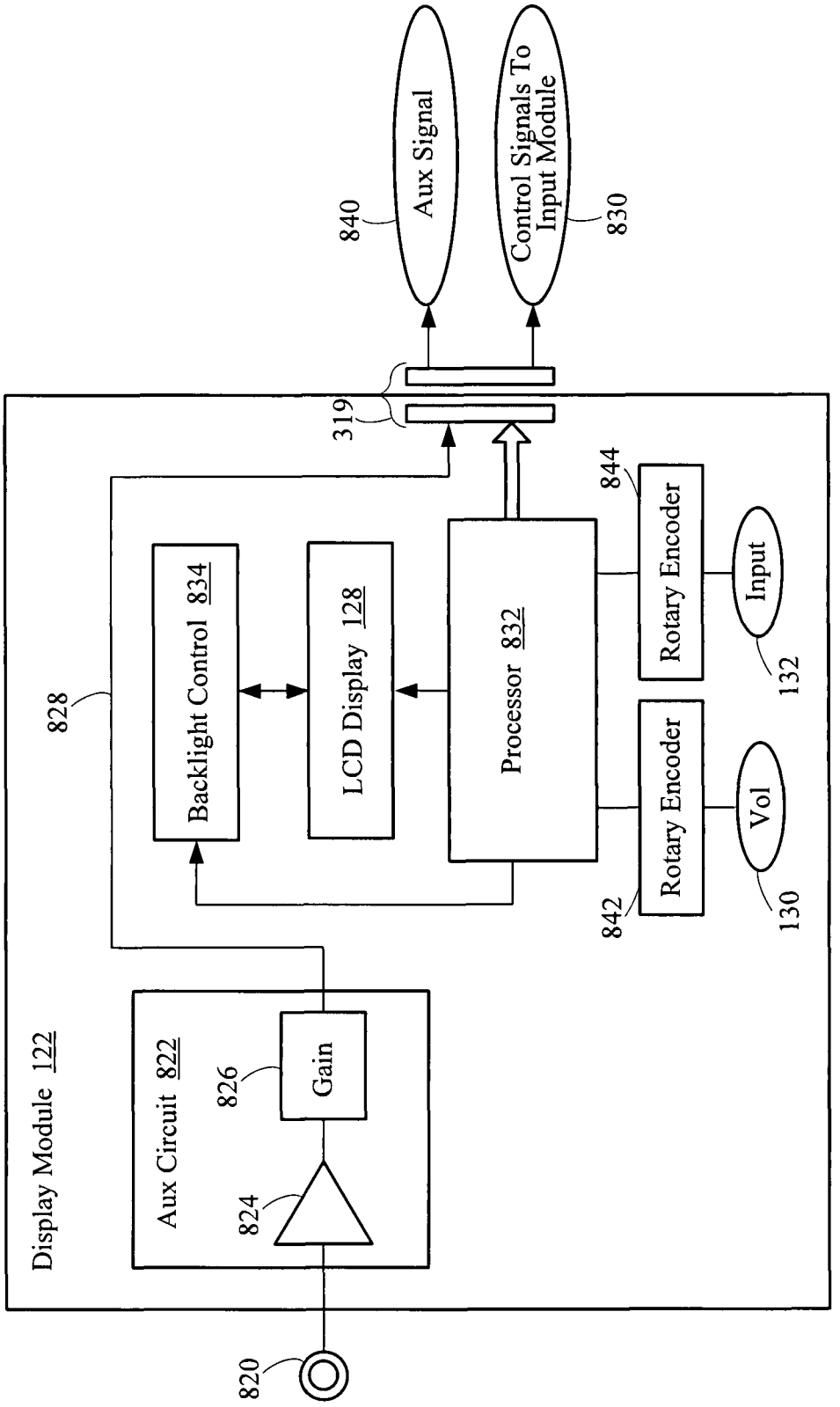

Aux Signal
840
Control Signals To Input Module
830
319
Display Module 122
828
Backlight Control 834
LCD Display 128
Processor 832
844
Rotary Encoder
Input
132
842
Rotary Encoder
Vol
130
Aux Circuit 822
826
Gain
824
820

Figure 8

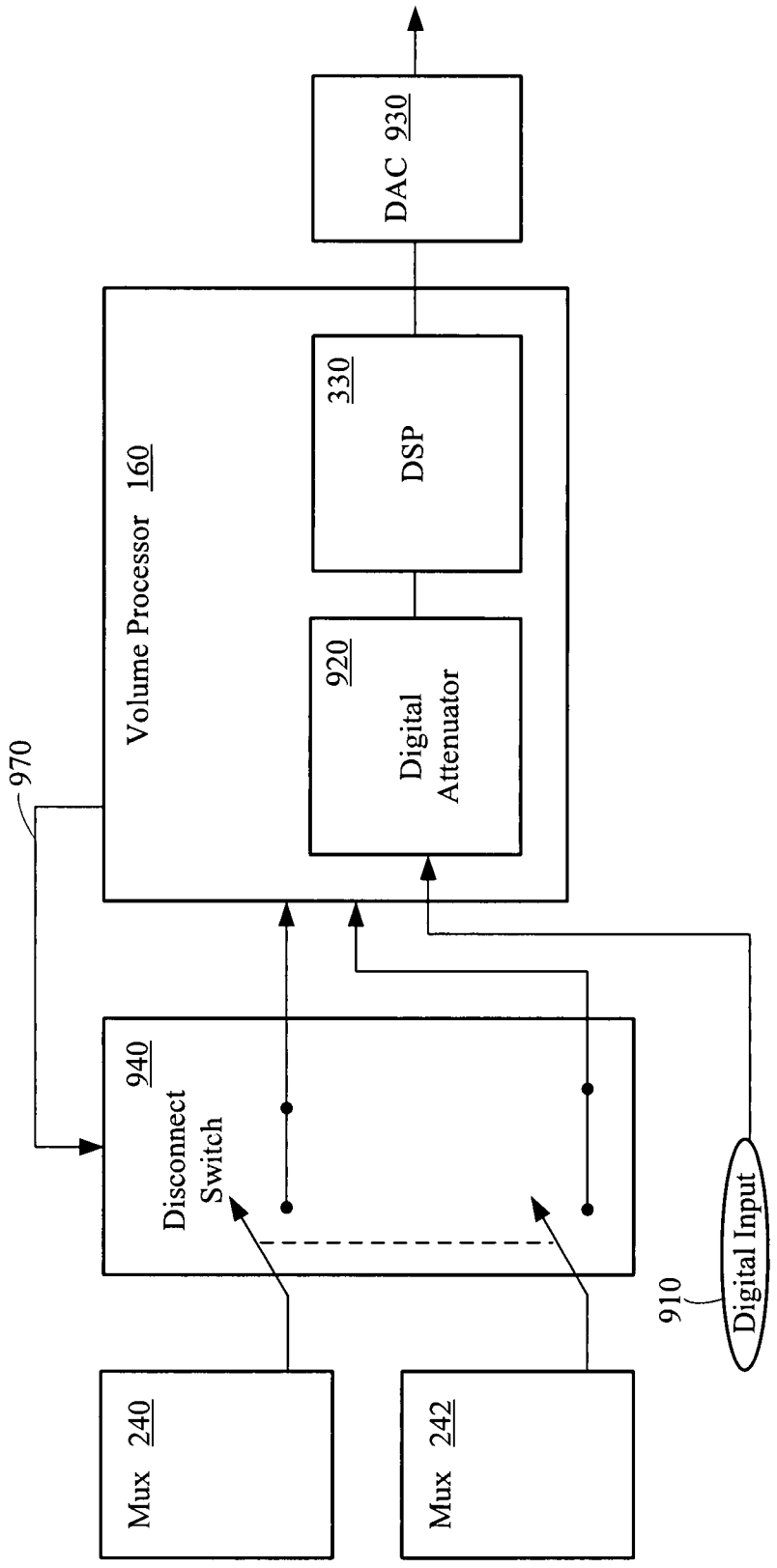

DAC 930
Volume Processor 160
330
DSP
920
Digital Attenuator
970
940
Disconnect Switch
910
Digital Input
Mux 240
Mux 242

Figure 9

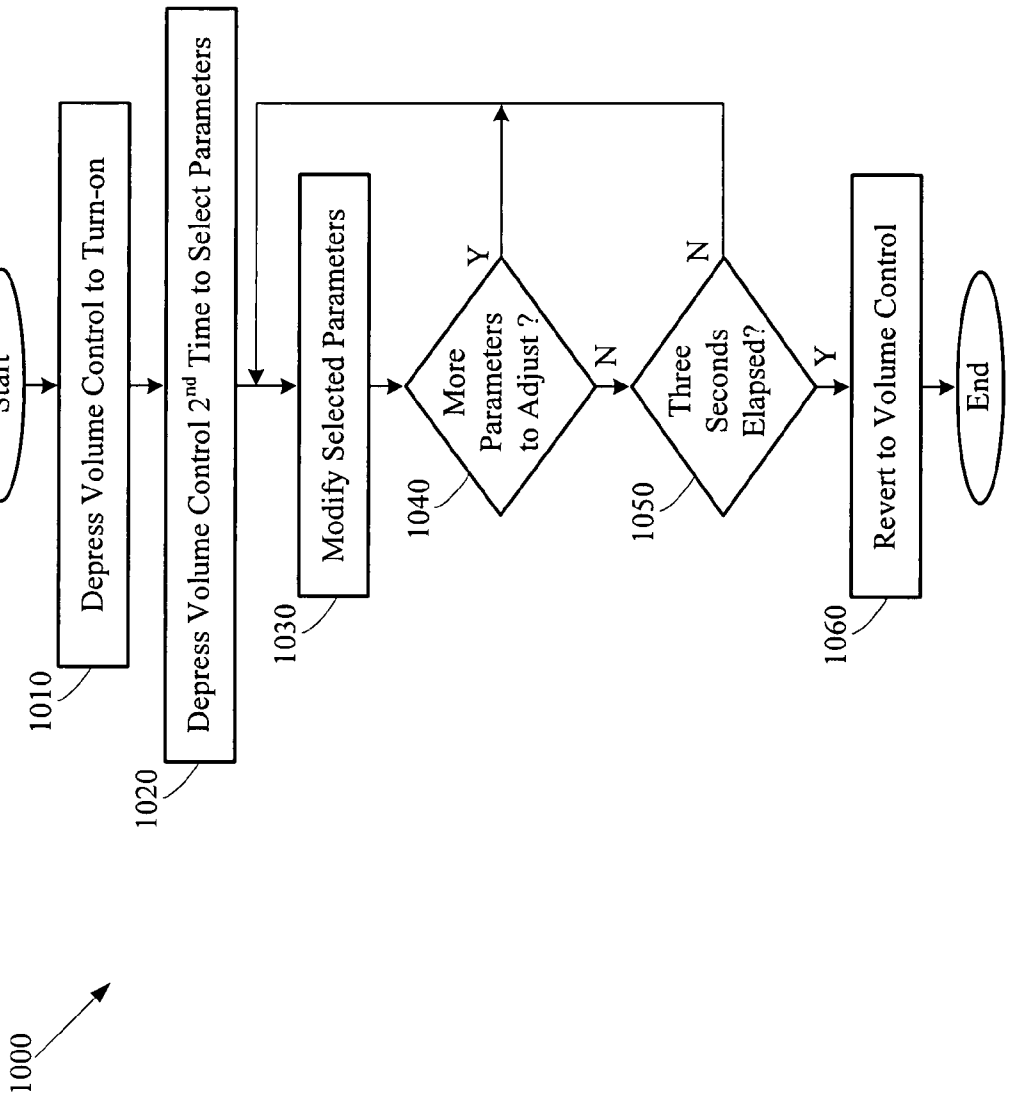

1000
Start
Depress Volume Control to Turn-on
1010
Depress Volume Control 2nd Time to Select Parameters
1020
Modify Selected Parameters
1030
More Parameters to Adjust ?
1040
Y
N
Three Seconds Elapsed?
1050
N
Y
Revert to Volume Control
1060
End

Figure 10

AUDIO CONTROL SYSTEM FOR A VEHICLE

PRIORITY CLAIM

This application claims the benefit of priority from U.S. Provisional Application No. 60/918,508, filed Mar. 16, 2007, which is incorporated by reference.

BACKGROUND OF THE INVENTION

1. Technical Field

This disclosure relates to an audio control system. In particular, this disclosure relates to an audio control system for a vehicle.

2. Related Art

Users may wish to upgrade factory-installed audio systems. Users may replace or upgrade the amplifiers associated with the factory-installed radios and CD players rather than replacing an original radio or CD player. Users sometimes attach additional devices or "sources" to the vehicle's audio system. Such sources may include navigation systems, cellular or wireless telephones, AM-FM radios, satellite radios, MP3-based players, DVD players and other devices.

It may be expensive and difficult to remove and replace existing factory-installed equipment. Dashboard modification and/or cosmetic changes may be required to accommodate new devices. Replacement devices may not fit in an existing dashboard resulting in less than a perfect appearance. Decorative face plates configured to hide poor fitting devices may not provide a professional or factory-installed look. Therefore, a need exists for an audio control system that can manage and control multiple audio sources without impacting the appearance of the vehicle's dashboard.

SUMMARY

An audio control system may receive a plurality of audio input signals. A switch or multiplexer may switch one of the plurality of audio input signals from respective audio sources to a power amplifier. A controller in communication with the multiplexer may control switching of the multiplexer. A display may provide the user with information regarding the switching of the audio signal inputs. A user interface may permit the user to manually switch the audio source. A signal detector in communication with an audio input signal may detect a signal from a priority source. When the signal from the priority source is detected, the controller may direct the multiplexer to route the signal from the priority source to the power amplifier.

Other systems, methods, features and advantages will be, or will become, apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The system may be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like-referenced numerals designate corresponding parts throughout the different views.

FIG. **1** shows a block diagram of the audio control system.

FIG. **2** shows an input/multiplexer portion of the audio control system.

FIG. **3** shows a logic and control portion of the audio control system.

FIG. **4** shows an output circuit of the audio control system.

FIG. **5** shows a three-way amplifier configuration.

FIG. **6** shows a five-way amplifier configuration.

FIG. **7** shows a bi-amplified amplifier configuration.

FIG. **8** shows a display module of the audio control system.

FIG. **9** shows additional features of the audio control system.

FIG. **10** is a flow diagram showing operation of the audio control system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** is a block diagram of an audio control system **110**. The audio control system **110** may be installed in a vehicle environment **112**. The audio control system **110** may include a display module **122** and an input module **124**. The display module **122** may include an LCD display **128**, a volume control **130** and an input control **132**. The display module **122** may be mounted or integrated within a dashboard or cluster of the vehicle **112** and may provide a user interface **134**. The display module **122** may be used in addition to original equipment manufacturer (OEM) devices, and may provide all of the user controls and visual output to the user. Accordingly, removal and/or modification of the existing OEM devices may not be necessary.

The LCD display **128** may include backlighting and dimming capability. However, any suitable display device may be used, such as a flat panel display or an electro-luminescent display. The display module **122** may have a body formed of molded plastic to present an aesthetically pleasing appearance. The volume control **130** may provide user-adjustable volume settings and power on/off functions. The input control **132** may provide system set-up functions, input labeling and input switching functions for each of a plurality of audio signal sources **136** through a command line interface, menu driven interface, and/or graphical user interface.

The display module **122** may communicate with the input module **124**. The input module **124** may be mounted in an enclosed area of the vehicle **112**, such as in the trunk, kick panel, behind the dashboard, below a seat, etc. The input module **124** may receive analog audio signals from the various source devices **136**. Such source devices **136** may include a navigation system **140**, a cellular or wireless telephone **142**, an AM-FM radio **144**, a satellite radio **146**, an MP3-based player **148**, DVD player **150** and CD player **152**. Other source devices may also be selected by the user.

The input module **124** may control switching of the various source devices **136** through commands from the display module **122**. A wiring harness **154**, which may be a unitary multi-wire cable, having connector hardware, may interface the display module **122** with the input module **124**. Because a wiring harness **154** may be used, the display module **122** may be mounted near or on the dashboard of the vehicle **112** without diminishing its appearance. The display module **122** may control setting the input voltage levels and gain parameters for the audio control system **110** during installation, or through a user-selectable calibration process. The process may ensure compatibility between the various source devices **136** and the input module **124**. The input module **124** may further include a volume processor **160** and a control processor **162**. The input module **124** may provide audio output

signals **166** to multiple power amplifiers **170** through an output connector block **172**. The power amplifiers **170** may drive a plurality of vehicle loudspeakers **176**.

The display module **122** may communicate with the input module **124**. The input module **124** may be mounted in an enclosed area of the vehicle **112**, such as in the trunk, kick panel, behind the dashboard, below a seat, etc. The input module **124** may receive analog audio signals from the various source devices **136**. Such source devices **136** may include a navigation system **140**, a cellular or wireless telephone **142**, an AM-FM radio **144**, a satellite radio **146**, an MP3-based player **148**, DVD player **150** and CD player **152**. Other source devices may also be selected by the user.

A buffer amplifier **228** or pre-amplifier may receive the input from each of the inputs, respectively. Each buffer amplifier **228** may be an operational amplifier. A gain adjustment circuit **236** may receive output from some or all of the respective buffer amplifiers **228**, and is thus shown in dashed lines. Note that each of the radio inputs **216** and **218** may be differential inputs. Accordingly, the corresponding buffer amplifier **230** for the radio inputs **216** and **218** may be arranged with a differential input. The differential inputs may reduce noise and increase signal quality. Some or all of the inputs and corresponding buffer amplifiers **228** and **230** may be arranged in a differential configuration.

The volume processor **160** may be programmed to control the respective gain adjustment circuits **236** to establish an appropriate input level for each corresponding audio source device **136**. For example, the gain adjustment circuit **236** for the navigation input may be programmed to receive a signal in the range of about 100 millivolts to about 16 volts. The gain corresponding to each input may be individually programmed depending on the expected output levels of the various audio source devices **136**.

A right channel multiplexer **240** and a left channel multiplexer **242** may receive the output from each gain adjustment circuit **236** respectively, or from the corresponding buffer amplifier **228** and **230** if no gain adjustment circuit is present. The right and left channel multiplexers **240** and **242** may be linear or analog multiplexers. The output of certain buffer amplifiers **228** or gain adjustment circuits **236** may be routed through additional pre-conditioning circuitry prior to routing to the multiplexers **240** and **242**. The volume processor **160** may receive a right channel audio output signal **250** from the right channel multiplexer **240**, and may receive a left channel audio output signal **252** from the left channel multiplexer **242**. The volume processor **160** may control switching of the multiplexers **240** and **242** through a multiplexer control signal **244**.

Some of the inputs corresponding to the respective audio source devices **136** may be prioritized. For example, the navigation input **212** and the telephone input **214** may have a higher priority than the other inputs. If the audio control system **110** detects an audio signal originating from the navigation input **212**, the navigation input may receive priority over all of the other inputs. Accordingly, if the radio **144** or CD player **152** is operating, and a signal from the navigation system **140** becomes active, the audio control system **110** may control the right and left channel multiplexers **240** and **242** to immediately switch the navigation system input **212** through the multiplexers and to the volume processor. The navigation input **212** may be assigned a highest priority so that the user will not fail to hear an audio navigation prompt. Thus, the navigation input **212** may "interrupt" or deselect all other inputs, regardless of which input is in use at the time.

A navigation signal detection circuit **260** may receive an output **254** from the amplifier **228** or the gain adjustment circuit **236** corresponding to the navigation input **212** to determine if a navigation device signal is present. The navigation signal detection circuit **260** may issue a navigation detection signal **262** to inform the control processor **162** if a navigation signal is present on the navigation input **212**. The user may also select the navigation source **140** manually or through voice-command or other telemetric-based device linked to the display module **122**.

If a signal on the navigation input **212** caused de-selection of another audio signal, the navigation detection circuit **260** may also detect when the navigation signal has terminated, and may restore the deselected audio signal. The navigation detection circuit **260** may delay restoration of the interrupted signal so as to make a smooth transition during switching. Such a delay may be, for example, about one to about two seconds.

The wireless telephone input **214** may be assigned to a second highest priority. Accordingly, receipt of a cellular or wireless telephone audio signal on the telephone input **214** may deselect all other sources in use, except for the navigation source **140**. In this way, the radio **144**, the CD player **152** or other audio source devices **136** may be deselected when the user receives a telephone call.

A telephone detection circuit **266** may receive a telephone output signal **264** from the respective buffer amplifier **228** (or gain adjustment circuit **236**) corresponding to the telephone input **214**, and determine if a wireless telephone signal is present. The telephone detection circuit **266** may issue a telephone detection signal **268** to inform the control processor **162** that the telephone signal is present on the telephone input **214**. The user may also select the telephone source **142** manually or automatically through voice-command or through a telemetric-based device linked to the display module **122**.

A short-range wireless decoder **270**, such as a Bluetooth® decoder, may couple the telephone input **214** to the multiplexers **240** and **242** to link the telephone **142**. The decoder **270** may include an antenna **272** and wireless transceiver circuit **274** configured to receive short-range radio signals. Various wireless telephone devices may be used, such as a Bluetooth® enabled cellular telephone. Other short-range cable-free decoders may be in communication with certain unallocated input sources to accommodate high-fidelity audio signals. Some of the decoders may be Bluetooth® decoders, such as an A2DP (advanced audio distribution protocol) decoder.

A telephone detection circuit **266** may receive a telephone output signal. **264** from the respective buffer amplifier **228** (or gain adjustment circuit **236**) corresponding to the telephone input **214**, and determine if a wireless telephone signal is present. The telephone detection circuit **266** may issue a telephone detection signal **268** to inform the control processor **162** that the telephone signal is present on the telephone input **214**. The user may also select the telephone source **142** manually or automatically through voice-command or through a telemetric-based device linked to the display module **122**.

Alternatively, priority levels between some of the inputs may be reassigned under software control. The user may reprogram the priority levels by selecting the appropriate function using the volume control **130** or input control **132**. Additional signal detection circuits similar to the navigation detection circuit **260** may be provided. Signals provided to and from the additional signal detection circuits may be re-routed using transmission gates or mechanical relays, such as a reed relay, when the priority levels are modified under software control so as to maintain a correspondence with the

priority input to which it is associated. Accordingly, the user may have complete control over which input source device **136** is selected via the input control **132** located on the display module **122**. Thus, the user may chose between the various input sources.

A signal summing circuit **280** may combine the telephone audio output signal **264** and the navigation audio output signal **254** to provide a summed signal. The signal summing circuit **280** may be an operational amplifier arranged in a summing configuration. This may permit the user to hear both audio signals so that the user does not miss the navigation information or a telephone call.

FIG. **3** shows a logic and control portion **310** of the input module **124**. The volume processor **160** may receive the right channel audio signal **250** and the left channel audio signal **252** from the respective multiplexers **240** and **242**. The volume processor **160** may process the left and right channel audio signals **250** and **252** and route conditioned output signals **312** to a plurality of output buffer amplifiers **314**. The conditioned output signals **312** may include a right channel output signal **316** and a left channel output signal **318**. The output buffer amplifiers **314** may be operational amplifiers arranged in a unity gain configuration, or may provide a predetermined amount of gain. The output buffer amplifiers **314** may be configured to isolate and prevent damage to the circuitry should the output signals **166** to the power amplifiers **370** become short-circuited.

A connector arrangement or jack **319** may couple the control processor **162** to the display module **122** using a minimal number of wires. A standard DIN type connector may be used. A serial communication format may be used to minimize the number of wires.

FIG. **3** shows a logic and control portion **310** of the input module **124**. The volume processor **160** may receive the right channel audio signal **250** and the left channel audio signal **252** from the respective multiplexers **240** and **242**. The volume processor **160** may process the left and right channel audio signals **250** and **252** and route conditioned output signals **312** to a plurality of output buffer amplifiers **314**. The conditioned output signals **312** may include a right channel output signal **316** and a left channel output signal **318**. The output buffer amplifiers **314** may be operational amplifiers arranged in a unity gain' configuration, or may provide a predetermined amount of gain. The output buffer amplifiers **314** may be configured to isolate and prevent damage to the circuitry should the output signals **166** to the power amplifiers **370** become short-circuited.

The control processor **162** may communicate with the volume processor **160** and may also receive the navigation detection signal **262** and the telephone detection signal **268**. The control processor **162** may effect control of the navigation input **212** and the telephone input **214** to interrupt other source devices **136** in a priority-mode state. The control processor **162** may also provide a mute control signal **340** to the output buffer amplifiers **314**.

FIG. **4** shows additional details of an output circuit **410**, which may include the output buffer amplifiers **314** and the output connector blocks **172**. The output connector blocks **172** may include dual output jack configurations in the form of RCA-type connectors **420** and RJ45-type connectors **422**. Multiple output jacks **420** and **422** may provide universal connectivity. Any number of connectors may be used in alternative systems. The output jacks **420** and **422** may route the audio output signals **166** to the multiple power amplifiers **170**. The multiple power amplifiers **170** may be located remote from the controller (e.g., in the trunk of the vehicle).

A sub-woofer summing circuit **426** may combine or sum the right channel audio output signal **316** and the left channel audio output signal **318** from the volume processor **160** to generate a monaural subwoofer audio signal **428**. The sub-woofer summing circuit **426** may be an operational amplifier arranged in a summing configuration.

FIG. **4** shows additional details of an output circuit **410**, which may include the output buffer amplifiers **314** and the output connector blocks **172**. The output connector blocks **172** may include dual output jack configurations in the form of RCA-type connectors **420** and RJ45-type connectors **422**. Multiple output jacks **420** and **422** may provide universal connectivity. Any number of connectors may be used in alternative systems. The output jacks **420** and **422** may route the audio output signals **166** to the multiple power amplifiers **170**. The multiple power amplifiers **170** may be located remote from the controller (e.g., in the trunk of the vehicle).

A sub-woofer summing circuit **426** may combine or sum the right channel audio output signal . **316** and the left channel audio output signal **318** from the volume processor **160** to generate a monaural subwoofer audio signal **428**. The sub-woofer summing circuit **426** may be an operational amplifier arranged in a summing configuration.

The multiple RCA-type connectors **420** may include front speaker connectors **430**, rear speaker connectors **432** and a subwoofer connector **434**. Corresponding signals are provided to the RJ45-type connectors **422**, which may include front speaker connectors **436**, rear speaker connectors **438** and a subwoofer connector **440**. The RCA-type connectors **420** and the RJ45-type connectors **422** may be functionally equivalent.

FIG. **7** shows an alternative bi-amplified five-channel configuration. The front speakers may be bi-amplified such that there may be separate amplifiers for tweeters **710**, mid-range speakers **712** and a subwoofer speaker **714**. The bi-amplified configuration may include a first stereo power amplifier **720** that may drive the tweeters **710**. Because no crossover circuitry is provided in the loud speakers, a high-pass filter or crossover circuit **722** may connect the front input connectors **430** to the first stereo power amplifier **720** to provide the high-frequency audio signals. Similarly, a band-pass filter or crossover circuit **724** may connect the rear input connectors **432** to a second stereo power amplifier **728** to provide the midrange audio signals. Finally, a low-pass filter or crossover circuit **732** may connect the rear input connectors **434** to a third power amplifier **734** to provide the subwoofer audio signals. The amplifiers may be configured to provide LOGIC7 Surround Sound (trademark of Lexicon Corp., a division of Harman Specialty Group of Massachusetts). The power amplifiers may be Class-D power amplifiers.

FIG. **6** shows a five-channel amplifier configuration. Only the five RCA-type connectors **420** are shown to avoid duplication. A five channel configuration may include a first power, amplifier **610** that may drive a front left-side speaker **612**, a second power amplifier **614** that may drive a front right-side speaker **616**, and a third power amplifier **618**, that may drive a subwoofer speaker **620**. Additionally, a fourth power amplifier **630** may drive a rear left-side speaker **632**, and a fifth power amplifier **634** may drive a rear right-side speaker **636**.

A single harness, such as the DIN-type cable or connector **319**, may connect the display module **122** and the input module **124**. The display module **122** and the input module **124** may communicate using various command and control signals **830** transmitted through the connector **319**. The display module **122** may include a separate microprocessor **832** and a backlighting circuit **834**. The display module **122**, including the LCD display **128**, may receive power from the power

supply located in the input module. Alternatively, the display module **122** may connect to the input module **124** wirelessly so as to eliminate the DIN-type cable and connector **319**. In such a configuration, the input module **122** may receive power from an internal battery, or vehicle power bus, or another source.

A first rotary encoder **842** may receive input from the volume control **130** of the display module **122**. A second rotary encoder **844** may receive input from the input control **132** of the display module **122**. The encoded information may be transmitted to the control processor **162** of the input module **124** via serial lines through the connector **319**. The rotary encoders **842** and **844** may additionally provide push and hold notification corresponding to depression and holding of the corresponding controls **130** and **132**.

FIG. **9** shows an alternate arrangement that may include an eighth input **910** ("digital input"), which may receive digital audio signals from a digital device, such as from a DVD player. Again, although a single line may be shown in FIG. **9**, the digital signal may be a stereo signal, including left and right channel signals. The configuration of FIG. **9** may include the components shown in FIGS. **2** and **3**, where and like-referenced numbers are used to denote the same or similar components. For clarity, other components of FIGS. **2** and **3** are not duplicated.

A first rotary encoder **842** may receive input from the volume control **130** of the display module **122**. A second rotary encoder **844** may receive input from the input control **132** of the display module **122**. The encoded information may be transmitted to the control processor **162** of the input module **124** via serial lines through the connector **319**. The rotary encoders **842** and **844** may additionally provide push and hold notification corresponding to depression and holding of the corresponding controls **130** and **132**.

FIG. **10** is a flow diagram showing acts **1000** that may be taken during operation of the audio control system **110**. The user may depress or push in the volume control **130** to turn-on (Act **1010**) the audio control system **110**. The user may depress or push in the volume control **130** a second time (Act **1020**) to access the tone, balance, and fader parameters. Turning the volume control in a clockwise or counter-clockwise direction (Act **1030**) may change the selected parameter. If additional parameters require changing (Act **1040**), the user may push the volume control and modify the selected parameter. After a predetermined period of time, for example about three seconds (Act **1050**), if the volume control **130** is not depressed, the audio control system **110** may revert back to a volume control mode (Act **1060**).

The logic, circuitry, and processing described above may be encoded in a computer-readable medium such as a CDROM, disk, flash memory, RAM or ROM, an electromagnetic signal, or other machine-readable medium as instructions for execution by a processor or controller. Alternatively or additionally, the logic may be implemented as analog or digital logic using hardware, such as one or more integrated circuits (including amplifiers, adders, delays, and filters), or one or more processors executing amplification, adding, delaying, and filtering instructions; or in software in an application programming interface (API) or in a Dynamic Link Library (DLL), functions available in a shared memory, or defined as local or remote procedure calls; or as a combination of hardware and software.

The logic may be represented in (e.g., stored on or in) a computer-readable medium, machine-readable medium, propagated-signal medium, and/or signal-bearing medium. The media may comprise any device that contains, stores, communicates, propagates, or transports executable instructions for use by or in connection with an instruction executable system, apparatus, or device. The machine-readable medium may selectively be, but is not limited to, an electronic, magnetic, optical, electromagnetic, or infrared signal or a semiconductor system, apparatus, device, or propagation medium. A non-exhaustive list of examples of a machine-readable medium includes: a magnetic or optical disk, a volatile memory such as a Random Access Memory "RAM," a Read-Only Memory "ROM," an Erasable Programmable Read-Only Memory (i.e., EPROM) or Flash memory, or an optical fiber. A machine-readable medium may also include a tangible medium upon which executable instructions are printed, as the logic may be electronically stored as an image or in another format (e.g., through an optical scan), then compiled, and/or interpreted or otherwise processed. The processed medium may then be stored in a computer and/or machine memory.

The systems may include additional or different logic and may be implemented in many different ways. A controller may be implemented as a microprocessor, microcontroller, application specific integrated circuit (ASIC), discrete logic, or a combination of other types of circuits or logic. Similarly, memories may be DRAM, SRAM, Flash, or other types of memory. Parameters (e.g., conditions and thresholds), and other data structures may be separately stored and managed, may be incorporated into a single memory or database, or may be logically and physically organized in many different ways. Programs and instruction sets may be parts of a single program, separate programs, or distributed across several memories and processors. The systems may be included in a wide variety of electronic devices, including a cellular or wireless phone, a headset, a hands-free set, a speakerphone, communication interface, or an infotainment system.

The audio control system **110** may manage and switch multiple audio sources. The control system may receive audio source input from existing OEM provided devices **136**, such as the radio and CD player. The control system **110** may also receive audio source input from additional audio sources, such as navigation systems **140**, cellular or wireless telephones **142**, satellite radios **146**, MP3-based players **148**, DVD players **150** etc. The control system **110** may be an aftermarket or "add-on" system. Accordingly, removal or replacement of the OEM provided devices may be obviated, which may preserve the cosmetic appearance of the dashboard. Certain audio input sources may be prioritized such that audio signals from a high priority device, such as a navigation system or wireless telephone, may interrupt audio signals from lower priority devices.

While various embodiments of the invention have been described, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of the invention. Accordingly, the invention is not to be restricted except in light of the attached claims and their equivalents.

We claim:

1. An audio control system for managing a plurality of audio source devices, the system comprising:

a plurality of audio input signals, at least one of the audio input signals corresponding to a priority audio source device;

a gain adjustment circuit that receives at least one of the audio input signals and is configured to adjust gain for the at least one audio input signal received;

a switching circuit configured to select one of the plurality of audio input signals and switch the selected signal from the respective audio source devices through the switching circuit, wherein the switching circuit further

comprises a right channel multiplexer and a left channel multiplexer in communication with a volume processor, the volume processor receives a right channel audio output signal from the right channel multiplexer and a left channel audio output signal from the left channel multiplexer;

a controller in communication with the switching circuit to control switching of the switching circuit and in communication with the gain adjustment circuit to selectively establish an input level for at least one of the audio input signals;

a signal detector in communication with at least one of the audio input signals and configured to detect presence of a signal from the priority audio source device;

the controller directing the switching circuit to deselect an existing input and select an audio input signal corresponding to the priority audio source device when the signal from the priority audio source device is detected; and

a display module having an associated input control, the controller in communication with the display module and input control to provide reprogramming of priority levels associated with the audio input signals via user selection of the input control associated with the display module,

wherein the plurality of audio input signals include a telephone audio signal transmitted from a cellular telephone and a navigation audio signal transmitted from a navigation system;

wherein the switching circuit further includes a summing circuit for summing the telephone audio signal and the navigation audio signal to generate a summed signal that permits a user to receive first data on the telephone audio signal and second data on the navigation audio signal, and

wherein the controller is configured to interrupt at least one first audio source device that transmits a first audio input signal and to prevent transmission of the first audio input signal if the first audio input signal does not correspond to one of the telephone audio signal and the navigation audio signal for enabling the user to receive the first data on the telephone audio signal and the second data on the navigation audio signal without interruption from the first audio input signal.

2. The system according to claim **1** comprising a second signal detector configured to detect presence of a signal from a second priority audio source device, where the controller directs the switching circuit to deselect an existing audio input and select an audio input signal corresponding to the second priority audio source device, when a signal from the second priority audio source device is detected.

3. The system according to claim **2**, where if a selected audio input signal corresponds to the priority audio source device, the controller does not deselect the selected input when a signal from the second priority audio source device is detected.

4. The system according to claim **2**, where the controller changes a relative priority level of the priority audio source device and the second priority audio source device.

5. The system according to claim **1** comprising a display in communication with the controller, configured to provide information regarding switching of the audio input signals.

6. The system according to claim **1** comprising a user interface in communication with the controller configured to permit manual selection and switching of the audio input source through the switching circuit.

7. The system according to claim **1** comprising a wireless decoder circuit configured to transmit audio signals to the switching circuit.

8. An audio control system for managing a plurality of audio source devices, the system comprising:

a plurality of audio input signals, at least one of the audio input signals corresponding to a priority audio source device;

a gain adjustment means that receives at least one of the audio input signals and is configured to adjust gain for the at least one audio input signal received;

switching means configured to select one of the plurality of audio input signals and switch the selected signal from the respective audio source devices through the switching means, wherein the switching means further comprises a right channel multiplexer and a left channel multiplexer in communication with a volume processor, the volume processor receives a right channel audio output signal from the right channel multiplexer and a left channel audio output signal from the left channel multiplexer;

control means in communication with the switching means to control, switching of the switching means and in communication with the gain adjustment means to selectively establish an input level for at least one of the audio input signals;

signal detection means in communication with at least one of the audio input signals and configured to detect presence of a signal from the priority audio source device;

the control means directing the switching means to deselect an existing input and select an audio input signal corresponding to the priority audio source device when the signal from the priority audio source device is detected; and

a display module having an associated input control, the control means in communication, with the display module and input control to provide reprogramming of priority levels associated with the audio input signals via user selection of the input control associated with the display module,

wherein the plurality of audio input signals include a telephone audio signal transmitted from a cellular telephone and a navigation audio signal transmitted from a navigation system;

wherein the switching circuit further includes a summing circuit for summing the telephone audio signal and the navigation audio signal to generate a summed signal that permits a user to receive first data on the telephone audio signal and second data on the navigation audio signal; and

wherein the controller is configured to interrupt at least one first audio source device that transmits a first audio input signal and to prevent transmission of the first audio input signal if the first audio input signal does not correspond to one of the telephone audio signal and the navigation audio signal for enabling the user to receive the first data on the telephone audio signal and the second data on the navigation audio signal without interruption from the first audio input signal.

9. An audio control system for controlling a plurality of audio sources, the system comprising:

a plurality of audio input signals, at least one of the audio input signals corresponding to a priority audio source device;

a gain adjustment circuit that receives at least one of the audio input signals and is configured to adjust gain for the at least one audio input signal received;

a switching circuit configured to select one of the plurality of audio input signals, and switch the selected signal from the respective audio source device to an amplifier, wherein the switching circuit further comprises a right channel multiplexer and a left channel multiplexer in communication with a volume processor, the volume processor receives a right channel audio output signal from the right channel multiplexer and a left channel audio output signal from the left channel multiplexer;

a controller in communication with the switching circuit to control switching of the switching circuit and in communication with the gain adjustment circuit to selectively establish an input level for at least one of the audio input signals;

a display in communication with the controller and configured to provide information regarding switching of the audio input signals;

a user interface configured to permit manual switching of the audio input signals;

a signal detector in communication with at least one of the audio input signals configured to detect presence of a signal from a priority audio source device;

the controller directing the switching circuit to deselect an existing input and select an audio input signal corresponding to the priority audio source device when the signal from the priority audio source device is detected; and

a display module having an associated input control, the controller in communication with the display module and input control to provide reprogramming of priority levels associated with the audio input signals via user selection of the input control associated with the display module,

wherein the plurality of audio input signals include a telephone audio signal transmitted from a cellular telephone and a navigation audio signal transmitted from a navigation system;

wherein the switching circuit further includes a summing circuit for summing the telephone audio signal and the navigation audio signal to generate a summed signal that permits a user to receive first data on the telephone audio signal and second data on the navigation audio signal; and

wherein the controller is configured to interrupt at least one first audio source device that transmits a first audio input signal and to prevent transmission of the first audio input signal if the at least one audio device does not correspond to one of the telephone audio signal and the navigation audio signal for enabling the user to receive the first data on the telephone audio signal and the second data on the navigation audio signal without interruption from the first audio input signal.

10. The system according to claim **9** comprising a second signal detector configured to detect presence of a signal from a second priority audio source device, where the controller directs the switching circuit to deselect an existing audio input and select an audio input signal corresponding to the second priority audio source device when a signal from the second priority audio source device is detected.

11. The system according to claim **10**, where if a selected audio input signal corresponds to the priority audio source device, the controller does not deselect the selected input when a signal from the second priority audio source device is detected.

12. The system according to claim **11**, where the controller changes a relative priority level of the priority audio source device and the second priority audio source device.

13. The system according to claim **9** comprising a wireless decoder circuit configured to transmit audio signals to the switching circuit.

14. A method of managing a plurality of audio sources comprising;

receiving a plurality of audio input signals, at least one of the audio input signals corresponding to a priority audio source device;

selectively adjusting gain of at least one of the audio input signals to establish an input level for the at least one audio input signal;

selecting one of the plurality of audio input signals from respective audio sources and switching the selected signal into communication with an amplifier;

sending a right channel audio output signal from a right channel multiplexer to a volume processor and sending a left channel audio output signal from a left channel multiplexer to the volume processor;

displaying information regarding switching of the audio signal inputs; detecting presence of a priority audio input signal;

deselecting an existing audio input signal, reselecting the priority audio input signal, and switching the reselected signal into communication with the amplifier, when the priority audio signal is detected;

reprogramming priority levels associated with the audio input signals in response to user selection of displayed functions via an input control;

summing a telephone audio signal transmitted from a cellular telephone and a navigation audio signal transmitted from a navigation system to generate a summed signal that permits a user to receive first data on the telephone audio signal and second data on the navigation audio signal, the plurality of output signals include the telephone audio signal and the navigation audio signal; and

interrupting at least one first audio source device that transmits a first audio input signal and preventing transmission of the first audio input signal if the first audio input signal does not correspond to one of the telephone audio signal and the navigation audio signal for enabling the user to receive the first data on the telephone audio signal and the second data on the navigation audio signal without interruption from the first audio input signal.

15. The method according to claim **14** comprising:

detecting presence of a second priority audio input signal; and

when the signal from the second priority audio source device is detected then deselecting an existing audio input signal;

reselecting the second priority audio input signal; and

switching the reselected signal into communication with the amplifier.

16. The method according to claim **15**, where if a the priority audio input signal is selected, the priority audio input signal is not deselected when the second priority audio signal is detected.

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